Quantitative strength and characteristics of ion outflow
as a function of solar wind conditions and storm phase.

We propose to continue to study the response of ionospheric ion outflow during geomagnetic storm periods. In order to investigate the relationship between ion outflow and magnetospheric conditions as well solar wind driving, we concentrate on perigee/low altitude passes. Although this restricts the amount of data considerably, it also minimizes the effects of spacecraft potential and allows us to perform the investigation independent of PSI operations. Earlier in the POLAR mission, perigee passes afforded 2-4 30-minute snapshots of the ionospheric outflow conditions during various phases of a storm, all at more or less constant altitudes. With the apogee of POLAR now close to the equatorial plane, "perigee" passes for the purpose of this study have moved to higher altitudes, sample a larger altitude range per pass, and typically last longer. This improves sampling of individual storms as well as offers the opportunity to study similar storms at different altitudes.

During 1996-1999, over 50 Dst storm periods were encountered by POLAR. About 25% of the events detected at perigee were multi-species events (see Figure 3). There is no clear indication yet as to whether there are any similarities between those storms compared to "single-species" events as far as solar wind and geomagnetic activity conditions are concerned. Apparently, multi-species outflow at low altitudes is not a function of Dst.

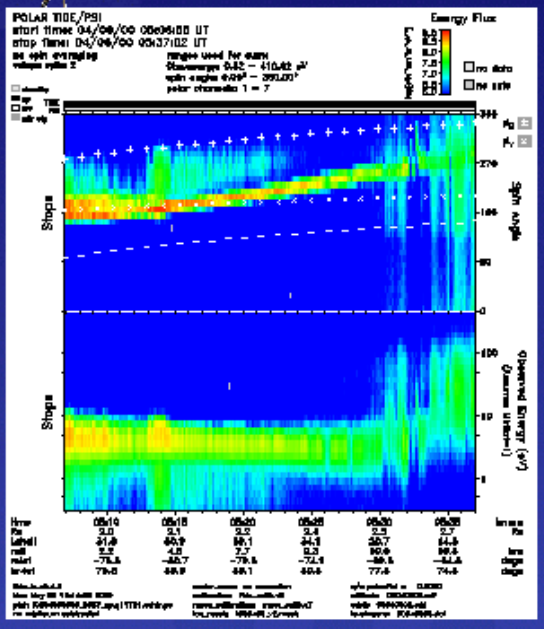
Figures 1 and 2 provide examples for two more recent Dst Storm periods when POLAR was in a midnight-to-noon pass at southern latitudes. The April 2000 storm is a more impulsive event (Dst - 323 nT within 6-7 hours) compared to March 2001, where Dst dropped to -165 nT in stages over nearly 24 hours. The last pass on March 19 is somewhat unusual with outflow reaching considerably onto the day side without occurrence of any of the precipitation features encountered in previous passes.

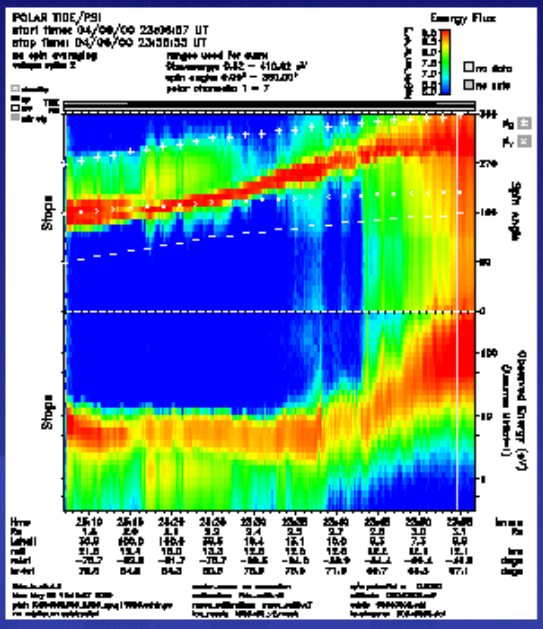
With an extensive database on Dst storms in hand, we are in the position to perform a "modified superposed epoch" analysis, where we superpose consecutive low-altitude passes as well as low-altitude passes from different storms (as long as the "profile" of those storms are similar, e.g. similar Dst profile or similar solar wind conditions). The goal is to derive an "average" time history of outflow as a function of storm phase. This analysis works best for April 06, 2000 type events where there was an impulsive stimulus to the magnetosphere, but it should also yield good results for more complicated magnetospheric storms. The result is an average outflow timeline for various storm types.

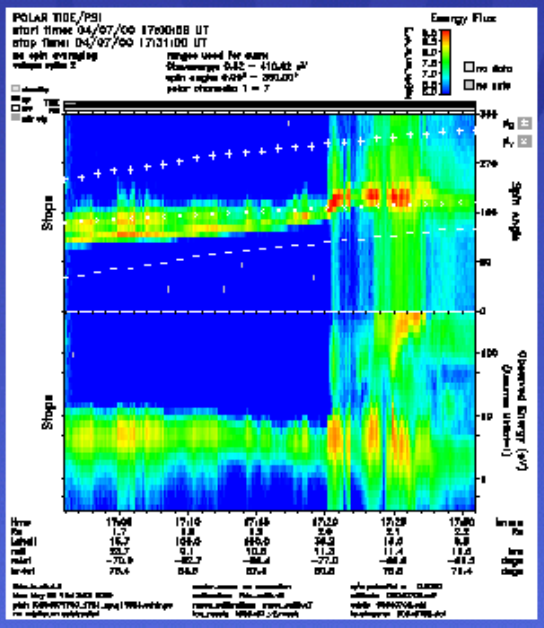
Extension to substorm intervals.

The techniques for investigating storms can be extended to examining the behavior of outflow during substorms. Substorms happen on much shorter time scales, which in return means that a single low-altitude pass may cover a more substantial portion of a single event. This can help answer the question of how much the outflow is changing during the course of substorm events.

April 06, 2000 – Perigee Pass Details







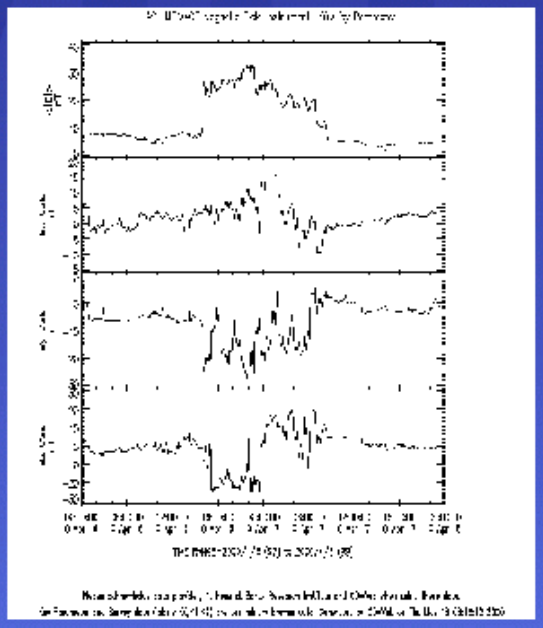
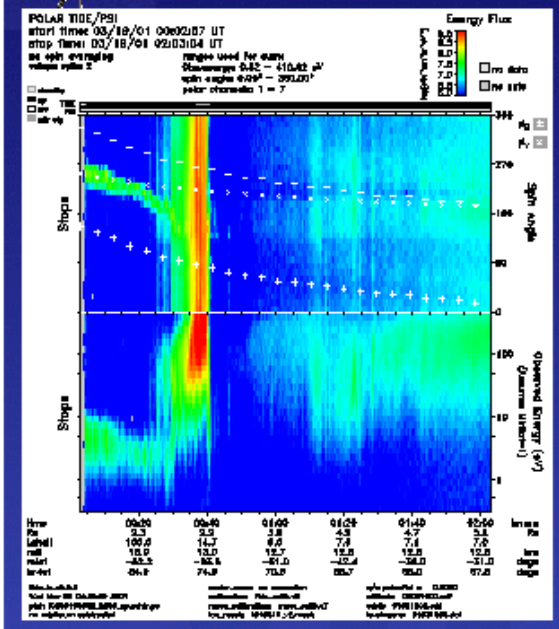
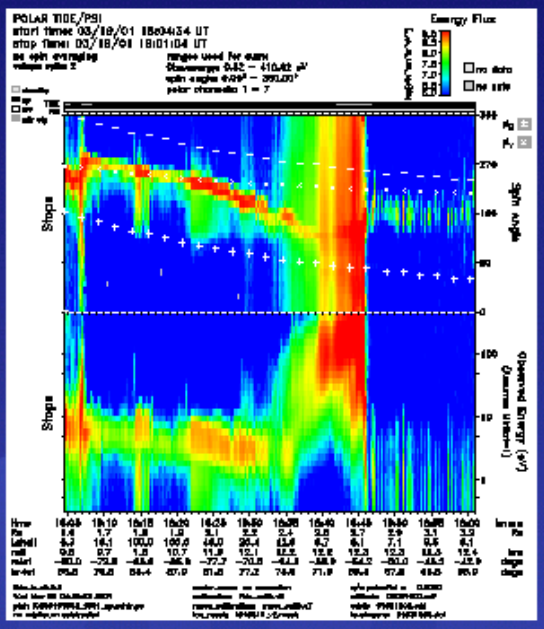
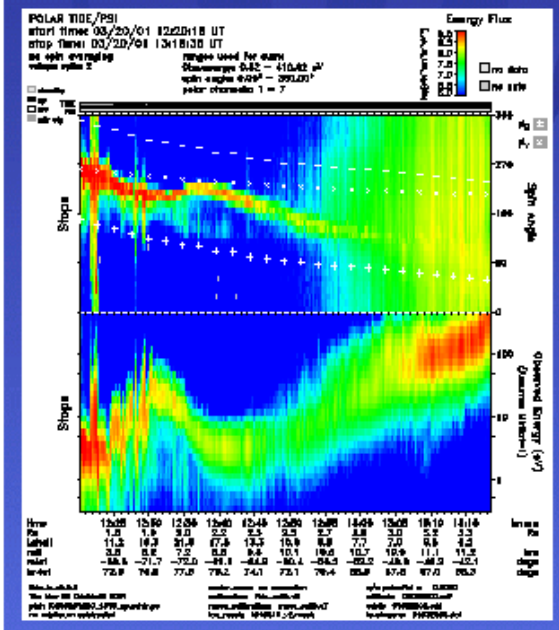


Figure 1

March 19, 2001 – "Perigee" Pass Details







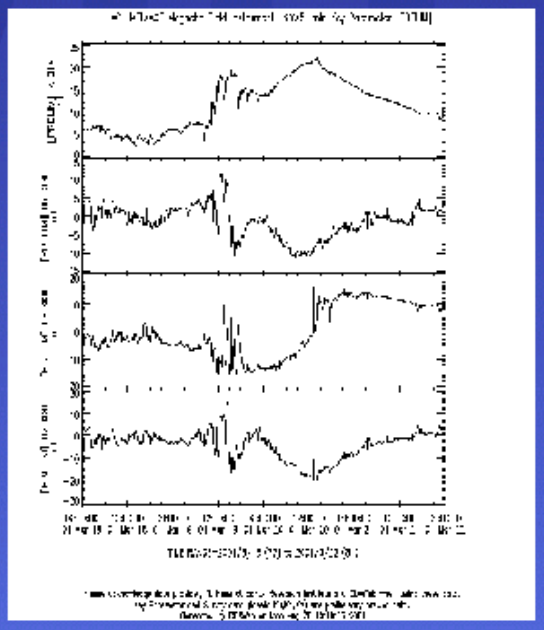
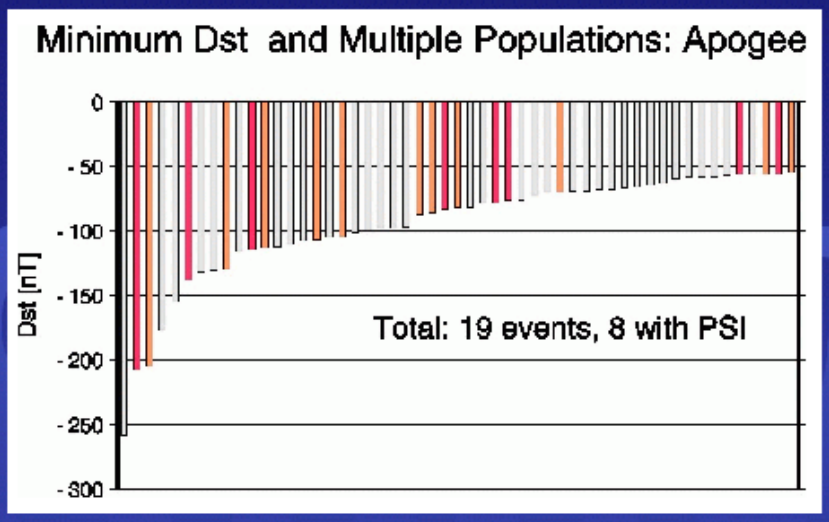


Figure 2

Outflow Population 1996–1999 as Function of Dst (multi–species events in color)



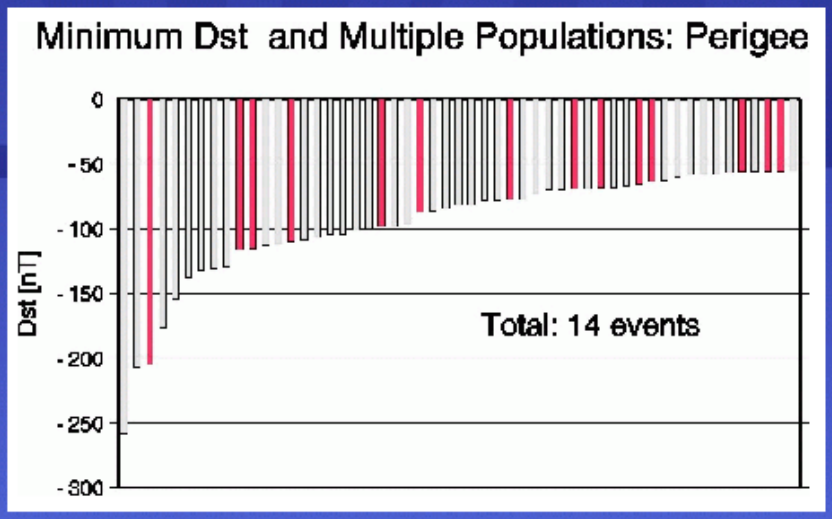


Figure 3